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Beta- and Gamma-Ray Spectrum of Cs^{13}. (II)

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The following sixteen papers are the second part out of sixty-seven papers, read before the semi-annual meeting of the Institute on June 5th and 6th, 1953.

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1. Beta- and Gamma-Ray Spectrum of Cs^{137}. (II)

Toshio AZUMA, Kunihiko TSUMORI and Kiichi KIMURA

(K. Kimura Laboratory)

We have investigated the character of the double coil, magnetic lens beta-ray spectrometer with the internal conversion line of Ba 137, and also evaluated the values of K/L and L/M ratios.

I. On the characters of the spectrometer.

(a) The scattering of the electrons in the spectro-chamber could be minimized using the aluminium baffle system which was the same type as those of Van Atta *et al.* (*Rev. Sci. Inst.* **21**, 985 (1950)).

(b) The axis of the spectrometer was checked with the K peak of the internal conversion electrons from Ba 137, whose image was photographed by the X-ray film exposed during five hours.

(c) The resolving power could be reduced to 1.4 percent with the source size of 2 mm. in diameter and the counter window of 3 mm. in diameter.

(d) The gathering power and the luminosity were 3.5/1000 and 1/100 respectively.

(e) The effect of the temperature rise of the lens coil was checked. The steady state of the coil temperature could be attained by the simple method of water cooling which was flowed in the space between the lens coil and the spectrochamber.

II. On the values of K/L and L/M ratios.

The sources were prepared by first defining the source area with insulin on a thin Aquadack Zapon film of about 30 $\mu g/cm^2$, thick to avoid the source charging up. The active material in solution was then applied to this area and dried fast under an infra-red lamp. The G-M counter used was an endwindow type whose mica thickness was 2.9 mg./cm^2.

The value of the internal conversion coefficient α_K was obtained as the ratio of the relative intensities of the reconstructed area of the 518 kev beta-ray spectrum and the area of the internal K conversion electrons. The momentum plot of the 518 Kev beta-ray spectrum was reconstructed from the corrected Fermi plot (first forbidden) to avoid the effect of the thickness of the counter window. The mean value of α_K obtained was 0.097 ± 0.005.

The L and M conversion peaks could be detected clearly when we used the stronger sources of about 30 and 60 microcurie equivalent intensities. The relative intensities of these conversion peaks were estimated from the area under each peaks which was the same method as those of α_K. The mean values obtained were 4.62 ± 018

for K/L ratio and 15.0 ± 1.6 for L/M ratio. The values of α_K and K/L ratio were assumed to be in accord with those of the former authors (M. A. Waggoner, *Phys. Rev.* **82**, 906 (1951); A. Mitchel and C. Peacock, *Phys. Rev.* **75**, 197 (1949)), and the value of L/M ratio was presented as a new value.

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2. New Methods of Dielectric Measurement in the Centimeter Wave Region

Isao TAKAHASHI, Mikio TAKEYAMA, Hideo SENO and Mitsuo ŌTA

(Nozu Laboratory)

In the previous paper (This Bulletin, **31**, 108 (1953)), we have proposed several new methods for dielectric measurement using the wave guide in the centimeter wave region. Our methods contain as special cases both the method by S. Roberts and A. von Hippel and that by W. H. Surber and G. E. Crouch which have so far been well used.

This time, we have derived the explicit expressions of ε^* which are expressed in terms of measured quantities only and very convenient and have ascertained that especially the method based on the following expression is very practical:

$$\varepsilon' = \left[1-\left(\frac{\lambda}{\lambda_c}\right)^2\right]\frac{(K_1-K_2)^2\frac{\Gamma_1}{\Gamma_2}-\left(\frac{1}{\Gamma_2}-\Gamma_1\right)^2K_1K_2}{\left[\left(\frac{1}{\Gamma_2}-\Gamma_1\right)K_1K_2\right]^2+\left[(K_1-K_2)\frac{\Gamma_1}{\Gamma_2}\right]^2}+\left(\frac{\lambda}{\lambda_c}\right)^2 \quad (1)$$

$$\varepsilon'' = \left[1-\left(\frac{\lambda}{\lambda_c}\right)^2\right]\frac{(K_1-K_2)\left(\frac{1}{\Gamma_2}-\Gamma_1\right)\left(K_1K_2+\frac{\Gamma_1}{\Gamma_2}\right)}{\left[\left(\frac{1}{\Gamma_2}-\Gamma_1\right)K_1K_2\right]^2+\left[(K_1-K_2)\frac{\Gamma_1}{\Gamma_2}\right]^2}. \quad (2)$$

The method is such that we measure Γ_i (VSWR) when we adjust the length l_i of the air column behind the sample with the plunger so that the position x_o of E_{min} measured from the front face of the sample may be $(2n+1)\lambda_g/4$ $(i=1)$ and $n\lambda_g/2$ $(i=2)$ and $K_i \equiv \tan 2\pi\, l_i/\lambda_g$.

Our experiments have been performed on $C_{15}H_{31}CH_2OH$ by using the above three methods with the frequency 9450 Mc/sec ($\lambda = 3.172$ cm), in which the values of the dielectric constant ε' agree in 3 significant figures: $\varepsilon' = 2.31$, and $\tan\delta$ lies within the range of about $(10 \sim 25) \times 10^{-2}$.

These methods can in principle be applied to any ε^*, no matter whether the loss be large or small, but in case of the sample of too small loss, the effect of the loss of the guide wall, the terminating plate and others must be considered. Accordingly, the fundamental equation including these losses has been derived: